

Notice of Allowability

Application No.

10/748,899

Examiner

David N. Spector

Applicant(s)

HUIBERS, ANDREW G.

Art Unit

2873

-- **The MAILING DATE of this communication appears on the cover sheet with the corresponding address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to FAOM.
2. ☒ The allowed claim(s) is/are 1-9 and 11-89.
3. ☒ The drawings filed on 29 December 2003 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date 1203
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 0504
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☒ Other DETAILED ACTION

David N. Spector
Primary Examiner
Art Unit: 2873

DETAILED ACTION - ALLOWANCE**EXAMINER'S AMENDMENT**

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee. Authorization for this examiner's amendment was given in a telephone interview with Gregory R. Muir on May 13, 2004. A summary of said interview is provided on a Form PTO-413B, attached hereto. Accordingly,

In the Claims

This listing of claims replaces all prior versions and listings of claims in the instant application.

1. (currently amended) A spatial light modulator, comprising: a substrate that is transmissive to visible light; a silicon substrate; wherein the silicon substrate and the substrate that is transmissive to visible light are bonded together with a spacer there between forming a gap between the substrates; and a plurality of deflectable elements enclosed encapsulated within the gap, and wherein the spacer is disposed within an area occupied by the plurality of deflectable elements.
2. (original) The spatial light modulator of claim 1, wherein deflectable elements are microelectromechanical deflectable elements.
3. (original) The spatial light modulator of claim 1, wherein the distance between the substrates is from 1 to 5 microns.
4. (original) The spatial light modulator of claim 1, wherein the substrate that is transmissive to visible light further comprises: a dielectric layer.

5. (currently amended) The spatial light modulator of claim 4, wherein the substrate that is transmissive to visible light further comprises: another dielectric layer, wherein said another dielectric layer has an optical index different from that of the dielectric layer.
6. (original) The spatial light modulator of claim 1, wherein the substrate that is transmissive to visible light is glass.
7. (original) The spatial light modulator of claim 1, wherein the substrate that is transmissive to visible light is quartz.
8. (original) The spatial light modulator of claim 1, further comprising: a first pattern on the substrate that is transmissive to visible light; a second pattern on the silicon substrate; and wherein the first and second patterns are aligned together when the substrates are bonded together.
9. (original) The spatial light modulator of claim 1, wherein the spacer is surrounded by a plurality of deflectable elements; and wherein each of the plurality of deflectable elements has an edge coplanar with a corresponding edge of the spacer.
10. (deleted)
11. (original) The spatial light modulator of claim 1, wherein the substrates are bonded together with the spacer therebetween using an adhesive.
12. (original) The spatial light modulator of claim 11, wherein the adhesive is epoxy.

13. (original) The spatial light modulator of claim 1, wherein the substrates are aligned together such that each deflectable element is aligned with an electrode.
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14. (original) The spatial light modulator of claim 1, wherein the spacer is positioned outside the plurality of deflectable elements.
15. (original) The spatial light modulator of claim 1, wherein the deflectable elements are mirror plates.
16. (currently amended) The spatial light modulator of claim 1, ~~where-in~~ wherein the deflectable element comprises a ceramic material.
17. (original) The spatial light modulator of claim 16, wherein the ceramic material is silicon dioxide or silicon nitride.
18. (original) The spatial light modulator of claim 17, wherein the deflectable element comprises a light reflection layer.
19. (original) The spatial light modulator of claim 15, wherein each mirror plate is attached to a hinge such that the mirror plate is operable to rotate.
20. (original) The spatial light modulator of claim 19, wherein the hinge is a torsion hinge.
21. (original) The spatial light modulator of claim 19, wherein the mirror plate comprise a first and second portions such that during the rotation of the mirror plate, the second portion moves towards the glass substrate and the first portion moves away from the glass substrate; and wherein the hinge and the mirror plate are positioned in different planes.

22. (original) A spatial light modulator, comprising: a first substrate having a plurality of micromirrors and a spacer that is positioned within the plurality of micromirrors; and a second substrate having an array of electrodes and circuitry, wherein the first and second substrates are bonded together with the spacer between the first and second substrates.
23. (original) The spatial light modulator of claim 22, wherein the first substrate is transmissive to visible light; and wherein the second substrate is a silicon substrate.
24. (original) The spatial light modulator of claim 23, wherein the first substrate is glass.
25. (original) The spatial light modulator of claim 23, wherein the first substrate is quartz.
26. (original) The spatial light modulator of claim 22, wherein the distance between the substrates is from 1 to 5 microns.
27. (original) The spatial light modulator of claim 23, wherein the first substrate further comprises: a dielectric layer.
28. (original) The spatial light modulator of claim 27, wherein the first substrate further comprises: another dielectric layer, wherein said another dielectric layer has an optical index different from that of the dielectric layer.
29. (original) The spatial light modulator of claim 23, further comprising: a first pattern on the first substrate; a second pattern on the second substrate; and wherein the first and second patterns are aligned together when the substrates are bonded together.

30. (original) The spatial light modulator of claim 22, wherein the spacer is surrounded by a plurality of micromirrors, each of which has an edge coplanar with a corresponding edge of the spacer.
31. (original) The spatial light modulator of claim 22, wherein the substrates are bonded together with the spacer in between using with an adhesive.
32. (original) The spatial light modulator of claim 31, wherein the adhesive is epoxy.
33. (original) The spatial light modulator of claim 22, where in the micromirror comprises a ceramic material.
34. (original) The spatial light modulator of claim 33, wherein the ceramic material is silicon dioxide or silicon nitride.
35. (original) The spatial light modulator of claim 22, wherein the micromirror comprises a light reflection layer.
36. (original) The spatial light modulator of claim 35, wherein each micromirror has a mirror plate that is attached to a hinge such that the mirror plate is operable to rotate along a rotation axis.
37. (original) The spatial light modulator of claim 36, wherein the hinge is a torsion hinge.
38. (original) The spatial light modulator of claim 36, wherein the mirror plate comprise a first and second portions such that during the rotation, of the mirror plate, the second

portion moves towards the glass substrate and the first portion moves away from the glass substrate; and wherein the mirror plate and the hinge are positioned in different planes.

39. (currently amended) A spatial light modulator, comprising: a first substrate; a second substrate, wherein the first and the second substrates are bonded together with a spacer therebetween so as to form a gap between the substrates; and a plurality of micromirrors positioned within the gap, each micromirror further comprising: a mirror plate, further comprising: a first and second portions, wherein the second portion moves away from the first substrate when the first portion moves towards the first substrate; a hinge that is located in a plane other than a plane in which the mirror plate is located; and wherein the mirror plate is attached to the hinge such that the mirror plate is operable to rotate; and wherein the spacer is disposed within an area occupied by the plurality of deflectable elements.

40. (original) The spatial light modulator of claim 39, wherein the distance between the substrates is from 1 to 5 microns.

41. (original) The spatial light modulator of claim 39, wherein the first substrate is transmissive to visible light.

42. (original) The spatial light modulator of claim 41, where in the first substrate further comprises: a dielectric layer.

43. (original) The spatial light modulator of claim 41, wherein the first substrate is glass.

44. (original) The spatial light modulator of claim 41, wherein the first substrate further comprises: another dielectric layer, wherein said another dielectric layer has an optical index different from that of the dielectric layer.

45. (original) The spatial light modulator of claim 41, wherein the second substrate is silicon.

46. (original) The spatial light modulator of claim 45, further comprising: a first pattern on the first substrate; a second pattern on the second substrate; and wherein the first and second patterns are aligned together when the substrates are bonded together.

47. (original) The spatial light modulator of claim 39, wherein the spacer is surrounded by a plurality of micromirrors; and wherein each of said plurality of micromirrors has an edge coplanar with a corresponding edge of the spacer.

48. (original) The spatial light modulator of claim 39, wherein the substrates are bonded together with the spacer therebetween using an adhesive.

49. (original) The spatial light modulator of claim 48, wherein the adhesive is epoxy.

50. (original) The spatial light modulator of claim 39, wherein the substrates are aligned together such that each micromirror is aligned with an electrode.

51. (original) The spatial light modulator of claim 39, wherein the spacer is positioned outside the plurality of micromirrors.

52. (currently amended) The spatial light modulator of claim 39, ~~where-in~~ wherein the micromirror comprises a ceramic material.

53. (original) The spatial light modulator of claim 52, wherein the ceramic material is silicon dioxide or silicon nitride.

54. (original) The spatial light modulator of claim 52, wherein the mirror plate of the micromirror comprises a light reflection layer.

55. (original) The spatial light modulator of claim 54, wherein the hinge is a torsion hinge.

56. (currently amended) A method of modulating light, comprising: providing a spatial light modulator that comprises a first and second substrates, the first substrate being optically transmissive and being held above the second substrate, an array of electrostatically deflectable mirrors; each suspended by a hinge from the optically transmissive substrate, the second substrate containing an electrodes and circuitry; and a spacer disposed between the first and second substrates and within said array of deflectable mirrors; providing an incoming light beam that passes through the optically transmissive substrate and that is reflected by the electrostatically deflectable mirrors; applying a voltage bias between at least some of the mirrors and the corresponding electrodes so as to deflect the at least some mirrors due to electrostatic attraction; and deflecting the light beam back through the optically transmissive substrate.

57. (original) The method of claim 56, wherein the second substrate is a silicon substrate, and the electronic circuitry is electrical addressing circuitry.

58. (original) The method of claim 57, wherein the silicon substrate is a VLSI-fabricated silicon substrate.
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59. (original) The method of claim 57, wherein the silicon substrate ~~resembles~~ comprises a low-density DRAM.
60. (original) The method of claim 57, wherein the deflectable mirror is a mirror made of a film deposited as part of a process incompatible with VLSI processes.
61. (original) The method of claim 56, wherein the deflectable mirror is deflected using a MOS transistor on the second substrate.
62. (original) The method of claim 56, wherein the addressing circuitry ~~resembles~~ comprises a memory array.
63. (currently amended) A method of making a spatial light modulator, comprising: forming a plurality of micromirrors in an area on a first substrate; forming a plurality of circuitry and electrodes on a second substrate; and forming a spacer within the area of the plurality of micromirrors; joining the first and second substrates together with a the spacer therebetween by bonding with an adhesive.
64. (original) The method of claim 63, wherein the step of forming the micromirrors on the first substrate further comprises: coating an opaque layer on the first substrate, wherein the opaque layer is removed before joining the substrates.
65. (original) The method of claim 63, wherein the step of forming the micromirrors on the first substrate further comprises: depositing a dielectric layer on the first substrate.

66. (original) The method of claim 65, further comprising: depositing another dielectric layer on the first substrate, wherein said another dielectric layer has an optical index different from that of the dielectric layer.

67. (original) The method of claim 63, further comprising: dispensing an adhesive around the edge of the first or the second substrate.

68. (original) The method of claim 63, further comprising: dispensing an adhesive around the edge of the first and the second substrate.

69. (original) The method of claim 63, wherein the step of joining the substrates further comprises: aligning a pattern on the first substrate to another pattern on the second substrate.

70. (original) The method of claim 63, wherein the adhesive is epoxy.

71. (original) The method of claim 63, wherein the first and second substrates are aligned before bonding.

72. (original) The method of claim 63, wherein the first substrate is a light transmissive substrate.

73. (original) The method of claim 72, wherein the first substrate is glass.

74. (original) The method of claim 72, wherein the first substrate is quartz.

75. (original) The method of claim 63, wherein the second substrate is a silicon substrate.

76. (original) The method of claim 63, wherein the plurality of deflectable elements are formed by depositing a sacrificial layer on the first substrate, depositing one or more deflectable structural layers thereon, and releasing the micromirrors by removing the sacrificial layer.

77. (original) The method of claim 76, wherein the sacrificial layer comprises silicon.

78. (original) The method of claim 76, wherein the sacrificial silicon layer is removed with xenon difluoride.

79. (original) The method of claim 63, wherein the micromirrors are formed of a ceramic material.

80. (original) The method of claim 79, wherein the ceramic material is silicon dioxide or silicon nitride.

81. (original) The method of claim 63, wherein the plurality of circuitry resembles comprises memories memory circuitry.

82. (original) The method of claim 81, wherein the memory array comprises SRAM circuits to drive the electrodes.

83. (original) The method of claim 81, wherein the memories comprises DRAM circuits to drive the electrodes.

84. (currently amended) A method of modulating light, comprising: providing a spatial light modulator that comprises: a substrate that is transmissive to visible light; a silicon substrate

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having a plurality of electrodes and circuitry; wherein the silicon substrate and the substrate that is transmissive to visible light are bonded together with a spacer therebetween forming a gap between the substrates; and a plurality of deflectable elements enclosed ~~encapsulated~~ within the gap the plurality of deflectable elements occupying an area and said spacers disposed within said area; providing an incoming light beam that passes through the light transmissive substrate and that is reflected by the electrostatically deflectable elements; applying a voltage bias between the deformable element and the electrode so as to deflect the deflectable element due to electrostatic attraction; and deflecting the light beam back through the optically transmissive substrate.

85. (original) The method of claim 84, wherein the deflectable elements are micromirrors, each of which comprising: a mirror plate having a reflective surface for reflecting light; and a hinge to which the mirror plate is attached such that the mirror plate is operable to rotate.

86. (original) The method of claim 85, wherein the micromirrors are positioned on the substrate that is transmissive to visible light.

87. (original) The method of claim 85, wherein the micromirrors are positioned on the silicon substrate.

88. (original) The method of claim 84, wherein the silicon substrate is a VLSI-fabricated silicon substrate.

89. (currently amended) The method of claim 84, wherein the circuitry is an addressing circuitry resembling a comprising memory.

REASONS FOR ALLOWANCE

3. Claims 1-9 and 11-89 are allowed. Claim 10 is canceled under the above-noted examiner's amendment. An examiner's statement of the reasons for allowance follows.

4. The instant application is deemed to be directed to a novel/nonobvious adjunct to the methods and structures disclosed in the applications/patents cited under the heading "CROSS-REFERENCE TO RELATED CASES" which appears at the top of the first page of the instant application. The primary reason for the allowance of the instant application is the disposition of a spacer "within an area occupied by the plurality of deflectable elements" as recited in each of the instant independent claims (e.g. as in Claim 1, Claim 39; and/or alternatively as "positioned within the plurality of micromirrors" (Claim 22); "within said array of deflectable mirrors" (Claim 56); "within the area of the plurality of micromirrors" (Claim 63); and finally, a "plurality of deflectable elements occupying an area and said spacers disposed within said area" (Claim 84). The prior art taken either singly or in combination fails to anticipate or fairly suggest the limitations of applicant's independent claims, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The claimed invention is therefore considered to be in condition for allowance as being novel and nonobvious over prior art.

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

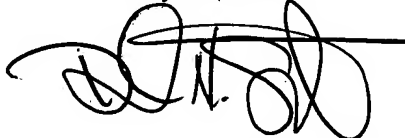
REMARKS

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Huibers (US 2004/0012838 A1) discloses a variety of spacer geometries in a copending application. Copies of this reference are not being furnished with this Office action. (See MPEP § 707.05(a).

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7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David N. Spector whose telephone number is (571) 272-2338. The examiner can normally be reached at this number Monday through Friday between 6:00 AM and 2:30 PM. In the event that attempts to contact the examiner by telephone are unsuccessful, the examiner's supervisor, Georgia Y. Epps can be reached at (571) 272-2328. The fax number for the organization where this application is assigned is (703) 872-9306.

May 16, 2004

A handwritten signature in black ink, appearing to read 'D. N. Spector', with a long horizontal line extending to the right.

David N. Spector
PRIMARY EXAMINER
AU 2873